

CLAIMS

1. A method of monitoring fluid flow in a closed conduit (5) including the disposition of a flowmeter (12) through which the fluid to be monitored flows, generating a signal indicative of at least one characteristic of the fluid flow, **characterised by** measuring the signal components and retaining the fluctuations associated therewith, and analysing the said signal components and fluctuations to determine the at least one characteristic of the fluid flow.
2. A method of monitoring according to Claim 1 for detecting two-phase fluid flow in a closed conduit including the disposition of a flowmeter through which the fluid to be detected flows, generating a signal indicative of at least one characteristic of the fluid flow, **characterised by** measuring the signal components and retaining the fluctuations associated therewith, and analysing the said signal components and the fluctuations to detect the presence of absence of two-phase fluid flow.
3. A method of monitoring according to Claim 1 or 2 for detecting two-phase fluid flow in a fluid flow in a closed conduit including the disposition of a vortex flowmeter through which the fluid to be detected flows, generating a signal indicative of at least one characteristic of the fluid flow, **characterised by** taking high frequency samples of the waveform of the oscillating vortex signal and retaining the fluctuations associated therewith for a single phase fluid flow, obtaining a frequency spectrum by taking the Fast Fourier Transform, calculating the logarithm of the spectral values, and calculating the mean value of the logarithmic spectral values to provide a datum for single-phase fluid flow, taking subsequent high frequency samples of the waveform of the oscillating vortex signal and retaining the fluctuations associated therewith from the two-phase fluid flow, obtaining frequency spectra by taking the Fast Fourier Transform, calculating the logarithm of the

spectral values, and calculating the mean value of the logarithmic spectral values to provide a datum for two-phase fluid flow and comparing the logarithmic mean value against the datum for single phase flow to detect the presence or absence of two-phase fluid flow.

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4. A method of monitoring according to Claim 1 for metering fluid flow in a closed conduit including the disposition of a fluid flow meter through which the fluid flow to be metered flows, generating a signal indicative of at least one characteristic of the fluid flow, **characterised by** measuring the signal components and retaining the fluctuations associated therewith, and analysing the said signal components and fluctuations to determine the volumetric flow rate of at least one phase of the fluid flow.
- 10 5. A method according to any one of the preceding claims **characterised in that** the flowmeter is a vortex flowmeter.
- 15 6. A method according to Claim 5 **characterised in that** the vortices generated by the vortex flowmeter are sensed by measuring frequency and amplitude components of the sensor signal.
- 20 7. A method according to Claim 6 **characterised by** the steps of calibrating the flowmeter (12) using a first reference flowmeter (8) to measure the liquid flow rate and a second reference flow meter (9) to measure the gas flow rate thereby to determine a relationship between signal amplitude components, the shedding frequency of the vortices generated within the vortex flowmeter (12), and the flow rates of the two components.
- 25 8. A method according to Claim 7 **characterised in that** the calibration includes conducting a series of tests to provide performance data over a range of flow rates with single and two-phase flows.
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9. A method according to Claim 7 or 8 characterised in that a multi layer neural network is employed as a method of handling the said performance data to provide measured values for primary and secondary phase flows.
10. A method according to Claims 7 or 8 characterised in that an analytical method is employed to handle the said performance data to provide measured values of primary and secondary phase flows.
11. A method according to Claim 8 characterised in that the calibration is conducted with two-phase flow on the basis of gas-in-liquid phases.
12. A method according to Claim 8 characterised in that the calibration is conducted with two-phase flow on the basis of liquid-in-gas phases.
13. A method according to Claim 11 characterised in that water is flowing at a constant rate and air is introduced at point (10) thereby causing an increase in the mean velocity of flow, the increase in the mean velocity of flow being itself indicative of the presence of a secondary fluid phase.
14. A method according to Claim 11 characterised in that an increase in the vortex shedding frequency occasioned by virtue of an increase in the mean velocity of flow is accompanied by a decrease in the amplitude of the shedding frequency component in the sensor signal.
15. A method according to Claim 13 characterised in that the decrease in amplitude is used as a determinant as to the presence of a secondary phase.

16. A method according to Claim 13 characterised in that the relative magnitude of the two phases is determined by the analysis and manipulation of the sensor signal from the vortex flowmeter.

5 17. A method of monitoring according to Claim 1 or 2 for detecting two-phase fluid flow in a fluid flow in a closed conduit including the disposition of a vortex flowmeter through which the fluid to be detected flows, generating a signal indicative of at least one characteristic of the fluid flow, characterised by measuring pressure
10 fluctuations from the upstream to downstream differential pressure across the vortex flowmeter, to generate a fluctuation signal, taking high frequency samples of the waveform of the differential pressure signal or pressure signal and retaining the fluctuations associated therewith for a single phase fluid flow, obtaining a frequency
15 spectrum by taking the Fast Fourier Transform of the signal, calculating the logarithm of the spectral values, and calculating the mean value of the logarithmic spectral values to provide a datum for single phase fluid flow, taking subsequent high frequency samples of the waveform of the differential pressure or pressure signal and
20 retaining the fluctuations associated therewith from the two-phase fluid flow, obtaining a frequency spectrum by taking the Fast Fourier Transform, calculating the logarithm of the spectral values, and calculating the mean value of the logarithmic spectral values, and comparing the logarithmic mean value against the datum for single
25 phase flow to detect the presence or absence of two-phase fluid flow.